# DYNAMICS OF LIGNIN IN RIVER WATER: HOW IS LIGNIN TRANSPORTED FROM RIVER TO OCEAN?

Misaki Nagayama [1], Masatoshi Nakakuni [1], Shuichi Yamamoto [1,2]

[1] Department of Environmental Engineering for Symbiosis, Faculty of Engineering, Soka University.
[2] Research Center for Natural Environment.

## Introduction

How is lignin transported from river to ocean? Organic matter transported via rivers plays an important role in transporting terrestrial carbon to ocean. Therefore, rivers are an important water system connecting the carbon cycle in terrestrial and ocean environment (e.g., Hedges and Parker, 1976; Berner, 1989). Lignin is a polymeric organic material constituting plant vascular tissue. Lignin inputs into lakes and oceans through rivers, and is widely detected from these sediments. Therefore, lignin has been used as a strong biomarker for land plants (e.g., Ishiwatari et al., 2006).

Dynamics of lignin in river water has not been clarified because it is difficult to extract organic matter (as dissolved organic matter, DOM) from a large amount of river water and amount of obtained organic matter is small. However, isolation procedure using DAX-8 resin made it possible to collect DOM from the river water. In addition, GC-MS analysis by tetramethylammonium hydroxide (TMAH) method is a useful method for an analysis of lignin and suitable for semi-microanalysis (Clifford et al., 1995). Therefore, the combination of these two methods makes it possible to analyse lignin in river water.

The purpose of this study is to grasp the dynamics of lignin in DOM from upstream to downstream in the water of Sagami river, Japan using the GC-MS TMAH method and isolation method by DAX-8 resin. In order to understand the dynamics of lignin in river water, we also measured temperature, pH and bacteria abundance in river water.

## Results and Discussion

In this study, variability in lignin concentration from upstream (st. 0) to downstream (st. 5) in the Sagami river was analyzed. In particular, in this abstract, in order to observe the degree of decomposition of lignin in the river water, ratios of acid to aldehyde for lignin phenol (Ad/Al ratios) are shown in Figure 1 with other factors (water temperature, pH, and abundance of bacteria). Among the factors, the abundance of bacteria and the Ad/Al ratios from the upstream to the downstream, show significant correlation ($r^2_{Pa/Ph}$ = 0.87 and $r^2_{Va/Vh}$ = 0.89, respectively). Also, those trends are shown in all analyzed months (November 2015, February 2016, and April 2016). Decomposition of lignin is recognized to be occurred by microbial degradation (e.g., Hackett et al., 1977; Hedges et al., 1982), but clear evidence in environment had remained unclear. Our results show a good relationship between the Ad/Al ratios and the bacterial abundance, which implies in situ microbial decomposition of lignin in environment. In this study, we could show one of the evidence of in situ microbial decomposition of lignin by analyzing the dynamics of lignin and bacteria in river water.

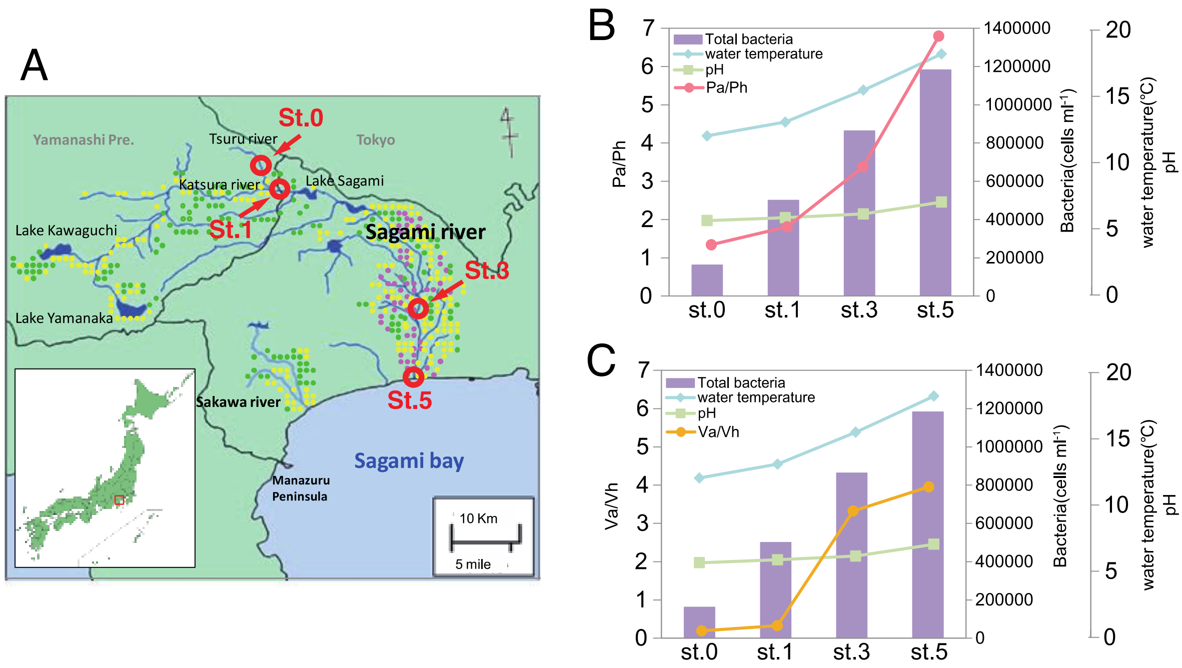


***Figure 1** Sampling location map and lignin phenol Ad/Al ratios (Pa/Ph and Va/Vh) in river water DOM and river water factors (water temperature, pH, and abundance of bacteria) from upstream (st. 0 –) to downstream (– st. 5) of Sagami river, Japan (November, 2015). (A) sampling location map, (B) Pa/Ph ratio in river water DOM and river water factors, (C) Va/Vh ratio in river water DOM and river water factors.*

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